SYNOPTIC NOTE

Title of the Research : Video Dehazing using Machine Learning Techniques

Course : Ph. D

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INTRODUCTION:

Computer vision systems are affected due to bad weather that reduces scene contrast and visibility. This results in degradation in the performance of various computer vision algorithms such as object tracking, segmentation, and recognition. A fast fog/haze removal algorithm for the image is crucial for the video fog removal. However, there are many challenges in the design of the video haze/fog removal algorithms. The object degradation in hazed image is related to object depth. So, the dehazing process depends on the input image/video frames. For real-time implementation, one needs to find the fastest algorithm with quality output. In the proposed research we consider different haze removal approaches to dehaze videos based on the dark channel prior.

Haze is a phenomenon which degrades visibility, from videos. It is caused by particles or water droplets in the atmosphere that absorb and scatter the light that travels from the source to the observer as stated by McCartney [McCartney E (1976) Optics of the Atmosphere: Scattering by Molecules and Particles. Pure and Applied Optics Series, Wiley and Sons]

$$I(x) = J(x)\, t(x) + A(1 - t(x)) \qquad \text{Eq (1)}$$

where I is the observed scene, J is the scene radiance, t is the medium transmission, A is the atmospheric light, and x= (x, y) are the horizontal and vertical positions of the pixel. The term $J(x)t(x)$ is the direct attenuation of the scene radiance and the term $A(1 - t(x))$ is the added atmospheric light which distorts scene colors. Haze removal problem aims at recovering J given only the observation I blindly with the absence of knowledge about both A

and t. Therefore, solving Eq. (1) is an ill posed inverse problem according to Hadamard [Hadamard J (1952) Lectures on Cauchy's Problem in Linear Partial Differential Equations. Dover Pub. Inc]. Some haze removal algorithms capture multiple images of the same scene under different settings to assist the recovery process. However, it is difficult to obtain extra images in practice in many consumer video cameras. The second approach is to impose extra constraints using knowledge or assumptions which are called priors such as the algorithms proposed by Tan [Tan R (2008) Visibility in bad weather from a single image. In: Proc. IEEE Conf. Computer Vision Pattern Recognition, pp 1–8, doi: 10.1109/CVPR.2008.458764329. Wu D, Zhu Q, Wang J, Xie Y, Wang L (2014) Image haze removal: status, challenges and prospects. In: Proc. IEEE Int. Conf. Information Science and Technology, pp 492–497,doi: 10.1109/ICIST.2014.6920524].

LITERATURE REVIEW:

Nishal P A et.al [1] describes a real time video fog dehazer for automobiles. An Introduction to the efficient method to dehaze fog in real time was used in the study. This method was assessed in terms of precision of image dehazing for restoring real-time foggy videos. The obtained result shows superior performance of the proposed method to compare the existing methods such as the dark channel prior and the color attenuation prior.

Lu Di et.al [2] describes "A real-time video defogging algorithm". Author proposed a fast and efficient real-time video defogging algorithm based on the pyramid model was used to solve the problems such as over-estimation of transmittance, color distortion in the sky region, and poor real-time performance in the current defogging algorithm. This method has an advantage of less running time and better video restore.

Dipali Bhajibhakre et.al [3] describes A Novel Method for Image and Video Dehazing based on Contrast Enhancement. Analysis of Video and Image affected by weather phenomenon and environmental conditions (nothing but Haze), an algorithm is proposed as, 'Contrast Enhancement'. This algorithm is applied to the Image and video and then we moving towards the Real-time video, which can be used in surveillance system, in the field of Public safety. Video and Image quality can be clear by estimating the airlight. Then, the depth estimation process is used to identify the depth information of given input. Finally gamma correction

technique is used to clear the quality or visual perception of image and video that results a pure, clear image and video which is visible to human eye.

Hayat Ullah et.al [4] illustrate a real-time video dehazing for industrial image processing for the fast and effective CNN architecture of haze removal, which directly generates clean image from input fogy image. Most of the industrial videos are captured in hazy weather and usually degraded by suspended particles of atmosphere, such as smoke, fog, rain, and snow, which limits the visual quality of image. This hinders the ability of artificial intelligent driven systems to achieve automation, reliability and accuracy. Recovery of the clear visuals from the input hazy videos is challenging problem. Instead of relying on explicitly estimating the key component of atmospheric scattering model, end-to-end CNN model is used, which directly recovers the clear images from hazy images.

YONGMIN PARK et.al [5] studied a fast execution schemes for dark-channel-prior-based outdoor video dehazing. DCP-based dehazing method was enhanced in order to make the dehazing process fast while maintaining a dehazing quality. For this purpose, the airlight estimation is performed based on distributed sorting with scaled luminance. The airlight estimation is executed selectively by exploiting the coherence between successive images in a video stream. In addition, the complexity involved in the transmission estimation is reduced by the assumption regarding the chrominance of the airlight. The overall execution time for dehazing a single image was reduced by 49% when tested under the prototype implementation. The dehazing quality was maintained even with such fast execution.

M.PADMAVATHI et.al [6] describes a novel approach for video dehazing using guided filter has been studied for an effective suppression of halo effects in the unrefined transmission map. the use of Guided filter with dark channel prior, gives an excellent dehazing effect and high processing speed. Additionally, annoying halo effects along depth edges have been significantly suppressed in restored images. The obtained results shows the superior haze removal effects and much faster refinement speed than can the modern filter.

Bolun Cai et.al [7] studied the Real-Time Video Dehazing Based on Spatio-Temporal MRF". An introduction to the notion of spatial consistency and temporal coherence to yield a dehazed video without blocking and flickering artifacts was described. Moreover, the integral image technique is applied to reduce the computational complexity significantly.

Jin-Hwan Kim et.al [8] describes the temporally coherent real-time video dehazing. The study proposes a real-time video dehazing method that minimizes flickering artifacts and produces high-quality output movies. A real-time video dehazing algorithm and a temporal coherence into the cost function to dehazed video without flickering artifacts was studied to replace the edge preserving overlapped block filter.

D. Shabna et.al [9] An Efficient Haze Removal Algorithm for Surveillance Video with a fast video defogging approach using haze image model with the same atmospheric light and transmission map was studied. This method is applicable under the situation that the camera is fixed and positioned high above the ground. Given a haze video, continuous haze-free video can be produced through haze image model with universal estimated atmospheric light and transmission map.

Apurva Kumari et.al [10] describes a real time image and video deweathering: the future prospects and possibilities. The study provides information on the availability of extremely high computational power at an affordable cost and has given shape to many new computer vision challenges. The real-time deweathering of images/videos is one such challenge which may come true in near future and the scattering mechanism, which degrades the image quality and also deweathering of degraded images were classified. Due to the availability of extremely high computational power at low cost, the real time deweathering of images can be feasible and useful for driving assistance, outdoor surveillance application and in many such other applications.

OBJECTIVES:

Video and images acquired by a visual system are seriously degraded under hazy and foggy weather, which will affect the detection, tracking, and recognition of targets. Thus, restoring the true scene from such a foggy video or image is of significance.

In outdoor vision applications such as surveillance camera system that require robust detection of image features. Under foggy weather conditions, the contrast and color of images are drastically altered or degraded. Hence, it is imperative to remove weather effects from video in order to make vision system more reliable. So far, there have been many works to remove fog from a single image, but only a few researches focus on video.

Due to the degradation of the image, the targets and obstacles of the image are difficult to detect. This is bad for automated video processing, such as feature extraction, target tracking, and recognition of objects. This is also one of the main reasons for accidents in the air, on the sea, and on the road. So it is important to design an image defogging algorithm to improve the environmental adaptability of the visual system.

With the development of computer technology, the video and image defogging algorithms have received much attention and are widely applied in civil and military fields, such as remote sensing, target detection, and traffic surveillance.

The objective of the research is to design image processing techniques to dehaze the performance with fewer artifacts and better coding efficiency.

PROPOSED METHODOLOGY:

We rely our work on the dark channel prior because it is fast and effective in most of the scenes. The challenge is in particular cases such as saturated objects or objects which are inherently similar to the atmospheric light and without shadow.

Empirical investigation of the characteristic of haze-free outdoor videos will be used in the study. Dark pixels whose intensity values are very close to zero for at least one color channel within an video patch will be selected and based on the observation, a dark channel is defined using the algorithms of He *et al*. 2011 [10]

$$J^{dark}(x)=\min_{y\in\Omega(x)}(\min_{c\in\{r,g,b\}}J^{c}(y)),J^{dark}(x)=\min_{y\in\Omega(x)}(\min_{c\in\{r,g,b\}}J^{c}(y)),$$

Where J^c is an intensity for a color channel $c \in \{r, g, b\}$ of the RGB image and $\Omega(x)$ is a local patch centered at pixel x. According to above equation, the minimum value among the three color channels and all pixels in $\Omega(x)$ is chosen as the dark channel $J^{\text{dark}}(x)$.

The transmission map should be object based at specific scene depth. Different approaches will be explored to obtain an object-based transmission map (He et al.2011 [7]) and to remove the blocking artifacts by edge-directed smoothing operation (soft matting method by Levin et al. 2008 [8]) and smoothing operation of Ke and Chen 2013[9] to smooth the dense field based on pixels which results in noisy incoherent transmission map by a moving average filter. The approaches may provide refined (enhanced) transmission map. A smoothing operation will be used to perform the coarse transmission. Finally, a gamma correction function will be applied to the smoothed transmission to avoid over haze removal and preserve a natural look for the scene (Ke and Chen 2013[9]).

Outcome:

Under cloudy and foggy conditions, video and pictures collected by a visual system are severely degraded, affecting target identification, tracking, and recognition. As a result, recovering the real scene from a hazy video or image is critical.

The techniques developed shall successfully decrease the effects of haze from video input at a high rate while maintaining high accuracy and avoiding significant changes in processing fewer artifacts.

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